The Bots,Borgs and [Genetically modified] Humans Welcome you to the Future[s] of Energetics

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- **Hunter-Gatherer - “Nature Provided”**
- **Agriculture - Controlled Nature (Plants/Animals), enabled Civilization**
- **Industrial - Mechanized Agriculture [1800-97% Farmers,Now-2%]**
- **IT/BIO/Nano - Automating Industry/Agriculture [~50’s/~60% manuf., Now/~12% heading to 2%]**
- **Virtual - Robotization of IT/Bio/Nano/Industry/Agriculture**

Technology MATTERS - For Both Good and ill……

Humans Have "Taken Over" and Vastly Shortened "Evolution"

- Human Engendered~E7 times "Natural"

<u>Of the Planet</u>

- Global Warming, Pollution, Deforestation, Species Extinction, Ground Cover changes, Ocean Acidification

- Huge "Public Works" (e.g. 3 Gorges Dam)

<u>Of the Human Species</u>

- Genomic Design and Repair

- "Mind Children" (Moravec)

<u>Products/Life Forms</u>

- Cross Species Molecular Breeding

- "Directed Evolution" (Maxygen etc.)

Prognosis - Serious Global Problems

[Engendered by Population Growth,~ 30% too many of us for the Ecosystem to support, if ROW attained U.S. Consumption rate would need 4 more planets…]

- **WARMING [Hyper-driven by positive feedbacks,immense potential impacts]**
- **ENERGY [Demise of "Cheap Oil",increasing Energy demands from the Rapidly developing nations/ROW]**
- **Fresh/Potable Water & Food……**
- **Arable Land**
- **Environmental Degradation**

“Prevention of collapse of the Ecosystem has now become the overwhelming issue”

European Commission on Key Technologies for Europe,2005

The Emerging Energetics Problem Space[s]

- Demise of “Cheap Oil”, huge demand/major price increases projected
- Anthropogenic “Greenhouse Gas Emissions” [Direct and Provoked], land use changes and results thereof
- 2nd Law of Thermodynamics [Waste Heat] Warming

Petroleum [Transportation Fuel] Outlook

- In General,"Cheap Oil" Production peaked in '05-'07.Residual supplies have greater production costs [Shale, Tar Sands, Coal - also produce far more CO2].Increasing Petroleum demand,particularly from the developing world ,will ensure ever increasing oil prices and shifts,from purely economic drivers, to "Alternatives" [H2,Biomass, Elec. Vehicles] - pumping 87M Bbls/day, using 86M, No "Margins"
- Demand Example - U.S. has 750 vehicles per 1000 population.China,the second largest oil importer, has some 6 vehicles per 1000 population.As China, an emerging major auto producer, doubles their vehicles per 1000 Population they will DOUBLE their Oil Imports, the oil is not there…….

Positive Feedbacks not included in Current Warming Estimates

- **Fossil Methane Release[s] [Tundra/Ocean]**
- **Tundra Soil and Ocean CO2 Releases**
- **Reduced Ocean CO2 uptake [Temp increase,Acidification,Algae Reductions]**
- **Further Albedo changes**
- **Further Water Evaporation**
- **Ocean Circul./O2 changes,H2S Prod.**

-Also,Considerable uncertainty in Ocean level Rise/Rate [Historical 2X predicted], Ocean Circulation changes and effects of Aerosols/clouds

How Far Off are the Climate/Warming Estimates?

- Projected arrival of ice-free Summers in the Arctic Ocean has shifted, in a few years [based upon "ground truth", what is actually happening] from 2100 to 2040 to 2013……..

- Greater than projected worst case CO_2 rise rate [Fossil tundra CO_2 and 50% reduction in Ocean CO_2 uptake?]

The “Great Dying” [The Permian [90%] Extinction- 250 MY ago] triggered [as was Venusian Warming] by massive Volcanic CO_2 & Particulate release. Anthropogenic CO_2 release[100X largest volcanic rate] is substituting for the Volcanic input, triggering the positive feedback mechanisms

2nd Law "Warming"

The fundamental/major/most worrisome "limit to growth" is the capability of the planet to reject (radiate to space) heat. Production of "power" for human utilization produces, via the second law of thermodynamics, immense amounts of "waste heat"--we are only two-to-three orders of magnitude from a monotonic rise in surface temperature (required to radiate this waste heat) --an excellent measure of a society's wealth is currently the power production per capita.As the ROW attains U.S. energy usage rates and population increases - This becomes a 'Limit" [Chaisson]

Rational[s] for “Going Green”

- **Escalating Price of Petroleum**
- **“Warming” [floods, storms, disease, ocean levels, droughts, species extinctions, tidal waves,Ocean Acidification,Ocean Circulation, H2S]**
- **National Security/Geo-Politics [Middle East and all that]**
- **Economics/ Balance of Payments[~ half of ~ $500B trade deficit is Oil]**
- **Personal Economics/ “Independence”**

Current Worldwide Energy Usage

- Petroleum - 140 Exojoules
- Natural Gas - 85
- Coal - 90
- Biomass - 55 [**Potential to 4,000+**]
- Nuclear Fission - 28
- Hydroelectric - 9
- Geothermal - 2 [**potential to 5,000**]
- Solar - .2 [**Potential to 4,000+]**
- Others [Wind, etc.] - ~7 [**Potential to ~2,000]**

Two Biomass/Biofuels "Revolutions"

- Halophytes
-Algae

[Biofuel sources that do not use fresh water/arable land, do not compete with food….]

Biomass Benefits

- **Renewable**
- **Nearly “CO2-Neutral”**
- **No New H2 infrastructure Required**
- **Minimal Sulfur**
- **Relatively Inexpensive**
- **Energy costs of biomass production/Processing up to an order of magnitude less than Energy “Yields”**

- Capacity/Tonnage Currently limited by “sweet” water and arable land

Sampling - Biomass Utilization Archipelago

- **Transportation/Liquid Fuels [Distill/Refine it] - Direct Petroleum Replacement**
- **Direct Heat Generation [Burn it] -Electrical Base Load**
- **Food**
- **“Petro-Chemical Feed-Stock [Plastics etc.]**
- **Direct H2 Production [Genomic Biologics]**
- **On Site Micro-Power/Co-[electricity] Generation**

“Water Scarcity is now the single greatest threat to Human Health,The Environment and the Global Food Supply”

The Emerging Desert Mantra [Some 44% of land worldwide is “Wasteland”]

- **<u>Desert Area Characteristics</u>**

- Sunlight

- Brackish/Saline Ground Water

- Many near/on seacoasts

- **Utilize these “Resources” For:**

- Nano-Plastic PV & Solar Thermal

- Saline/Seawater Agriculture for Biomass/Energy and Food using halophyte plant stocks

Saline/Seawater Agriculture

- Quasi-Conventional:
  - For Food & Fodder
  - “Reclaim”/Desalinate land via Biologics
- **<u>Unconventional</u>**
  - **For Land,Water,Energy,Warming,Minerals,Food and Terra-Forming/enhanced Rainfall i.e. STRATEGIC Not Tactical, to Contribute to ALL the Major Problems,not just food**

Advantages of Seawater AG

- **97% of all water is seawater,will not "Run Out"**
- **Seawater Contains:**
  - **wide variety of important minerals**
  - **~ 80% of Nutrients required for Agriculture [need to add Nitrogen,Phosphorus and Iron]**
- **In proximity to a number of Dry/Desert Areas**

Halophyte [Salt-Plant] Utilization [Per Yensen]

- **Patents issued for Halophyte Crop[s] [Genetics,Genomics]**
- **10,000+ “Natural” Halophyte Plants,250 of these are potential “Staple” crops**
- **Research ongoing on/for Halophilic [Salt-LOVING] Halophytes,The more salt the faster the growth…**
- **Huge areas worldwide are already salt-affected [1 B Hectares] and another Billion Hectares overlie Saline Aquifers.**
- **Over 100 halophyte plants now in “trials” for “Commercial” applications**

[Sample] Countries with Saline AG projects

- China
- Mexico
- Eritria
- India
- Pakistan
- Israel
- Libya
- Jordan
- Tunisia

- Current Status,Prototype Farms/Experiments for FOOD

- Egypt
- Iran
- Morocco
- U.S.
- Saudi Arabia
- Syria
- UAE
- Kuwait
- Australia
- Sudan
- Peru
- Chile

Chinese Seawater AG Reporting

- **Genetically Modified [grown on “Beaches” using Seawater]:**

- Tomato

- Eggplant

- Pepper

- Wheat

- Rice

- Rapeseed

Sample "Wastelands" Suitable for Halophyte Biomass production

- Western Australia
- Around the Arabian Sea/Persian Gulf
- Middle East
- The Sahara
- Southwest U.S. incl. West Texas
- Atacama in South America
- "Others" worldwide

Aquaculture…….

- Algae and Bacteria, capable of up to 100,000+ Gals fuel/acre-year [vice some 700 or less from Agriculture -], ~ 35%-60% Oil
- Prospective “Algae Ponds” within the U.S. include the Great Salt Lake, the Salton Sea , the “Dry Lakes” and waste water treatment plants, Then there is the Eastern Equatorial Pacific…..and “at home” growth/processing
- Uses “Waste” resources - Saline/waste water/land, ~ 1% of U.S. land mass to replace Petroleum vice 40%……

Algae Research Arenas

- “More Transparent” Algae to allow “multi-level” production [2X+].
- Increased Oil Content
- Increased Growth using less Nutrients
- Disease Resistance
- Optimized for bio-Refining Processes
- Growth in Cold Water

Revolutionary “Algae” Biofuel[s] Approaches

- Grown in Vertical Racks of Horizontal tubes, 33,000 gals/acre-year demonstrated, 100,000 may be possible
- Feed Algae Sugar from cellulose vice sunlight/CO2, greater oil production, order[s] of magnitude greater concentrations/productivity
- Bacteria [vice Algae] direct fuel production

Resultant Aircraft Emissions Solution Space”

HC Transportation Fuel obtained from Biomass, [“Unchanged” fuel infrastructure, fly below 27K Ft for water issue,Cost Effective, CO2 “price” paid “upfront” - plants take up the CO2]

-C-C enables wing size reduction and ride quality for less than 27k ft cruise, also Simultaneous multiple A/C runway utilization for Airport productivity

SYNOPSIS:

GREEN ENERGETICS

Green Energetic Sources - Part 1, the ‘Usual”

- **“As Available” Geothermal**
- **Silicon PV [with concentrators]**
- **Corn and Cellulose Arable Land /sweet water Biomass/Fuels**
- **Solar Thermal [with concentrators, up to 60,000 “suns”]**
- **Fission Nuc**
- **Terrestrial/offshore Windmills**
- **Hydro**
- **Waves**
- **Ocean Thermal**
- **Photo-Catalytic Electrolysis of H2O for H2**
- **‘Waste” Biomass [Trash, sewage [human/animal,…]]**

Green Energetic Sources - Part 2, The “Unusual”

- **Drilled, Hot Rock Geothermal**
- **Halophyte and Algae/Bacteria Bio fuels [Saline/Sea water]**
- **Plastic Nano PV**
- **Tidal Currents**
- **Genomic Biologic H2 Prod.**
- **Artificial Photosyn. For H2 Prod. & Atmos. CO2 processing into CO/Fuel[s]**
- **P-B11 Aneutronic Fusion NUC**
- **LENR’s**
- **ZPE**
- **Jet Stream Windmills**
- **Space Solar Reflectors**

Conservation - Part 1, the "Usual"

- Diesel IC Engines [+ 20% effic., + 15% energy density]
- Light Diodes/LED's
- Fuel Cells
- Waste Heat Recovery
- Insulation
- Landscaping [Berms, passive solar, windbreaks,….]
- Engineering "Redesign"
- "Behavior Changes [Walking, Sweaters, Etc…]

Conservation - Part 2, The "Unusual"

- CNT Computing & Elect. Loss Reductions
- Tele-Travel, Tele-Everything
- 30% plus Thermal-Electrics [serious waste heat recovery incl. power plants and parking lots]
- CNT/BNNT enabled weight reductions [Factors of 3 to 5], huge vehicle energy impacts
- Room Temp. S-C

Energy Storage - Part 1, The "Usual"

- Thermal storage utilized for T-PV and Sterling Engines
- Ultra Capacitors
- Batteries
- Flywheels
- Pumped H2O
- High Press. Gas [incl. underground]
- Water/H2, other Chem. Disassociation
- Ice Hills, other phase change
- SMES
- [Biomass derived] Hydrocarbon fuels

Energy Storage - Part 2, The "Unusual"

- SMES with CNT Magnets
- SBER
- Metal [e.g. Zinc, Al] H2 "storage"
- Isomers
- Positrons as Positronium
- Nano Casimir Force-Engineered H2 Storage
- Thermal accessed via low temperature high efficiency T-E
- The HEDM "Zoo" [N4, solid H2, Atomic Boron, Etc…….]

Energy Transmission - The Unusual

- High Voltage DC Transmission Lines
- [Room Temperature] S-C Transmission Lines
- Freespace Laser including Soliton Waves……..

LENR [Low Energy Nuclear Reactions]

- Originally dubbed “Cold Fusion”, an experimental discovery with replication issues and no acceptable theory
- Now, Almost 2 decades of massive world-wide data collection/experiments indicate is “real”
- Now, a viable Theory [Widom/Larsen]
- Not “Hot Fusion”, is electroweak interactions explicable via the “Standard Model” of Quantum Theory on Surfaces
- Theory being used to increase heat “quality” and practicality, no radioactivity safety issues
- Economics/Utility TBD…..

Drilled Geothermal

- Excellent recent MIT Study
- Usual Geothermal uses near-surface sources, limited in capacity/coverage
- For some 50% of many large land masses, if drill down 2 Km get 200+ degree C rock, 5 Km produces 300+ degree C rock.
- Drilling capability is some 10 Km
- Drill 2 somewhat adjacent holes,fracture rock in-between. Force 3,000 psi water down one hole and utilize the resultant Steam ejected from the other

Worldwide IT Revolution

- **Comms/Computing/Sensors/Electronics**
- **Factor of E07 since ’59 [Moores’ Law]**
- **Factor of E08 to E12 further improvement [Silicon,Molecular/CNT, Quantum, Bio, Optical]**
- **Beyond Human Machine Intelligence?**
- **Automatics/Robotics “in the large”**
- **Immersive multi-sensory VR/”Holodecks”**
- **Ubiquitous multi physics/hyperspectral sensors [land/sea/air/space]**

IMPACTS OF ONGOING IT REVOLUTION UPON SOCIETY

- **Work (at home telecommuting, reduced local/corporal travel)**
- **Shopping (at home web based, (robotic?) delivery)**
- **Entertainment/leisure (at home immersive 3-D interactive/multi-sensory via VR/holographhy**
- **Travel (3-D/interactive/multi-sensory tele-travel)**
- **Education (at home low cost asynchronous, web based on-demand, highly motivational, life-long distance learning, .edu)**
- **Health (at home interactive tele-medicine)**
- **Politics (increased real-time virtual involvement of the body politic)**
- **Commerce (tele-commerce already ubiquitous)**
- **Tele-Socialization, Tele -[onsite] Manufacturing**

Carbon Sequestration

- Spread Iron rich dust on Oceans to induce massive Algae blooms
- Biomass processing via pyrolysis to form “Charcoal”, bury to enrich soils
- Capture/Separate/Bury [**Expensive, “Leakage etc. TBD**…..]
- At-Sea Algae Processing [~ 30%]
- Genomic Biologics

OR…..

- Bio LENR Transmutation of Carbon into other elements [e.g. Iron - Larsen and Widom]

Feeding [Fossil] CO2 to Algae……

- An oft quoted approach to dealing with CO2 produced from Fossil fuels is to capture/feed it to Algae for Bio-Fuels. This increases the overall usable energy from the Fossil fuel and therefore reduces the net CO2 emission per unit of fossil fuel energy, but the fossil fuel-produced CO2 is still largely emitted into the atmosphere…….

Space Solar Power Issues….

- Of interest due to 24/7 Base load & 8X higher solar intensity

- Economics - Cost[s] of Space Access [~ order of magnitude too large], higher cost [rad hard] PV, Maintenance costs,
- Potential Energy Beam/Lobes effect[s] upon Biota, requires definitive studies [U.S. vs. Russian Exposure limits]
- Launch vehicle efflux effects [MANY launches]
- Potential storage solutions exist for competitive/competitor terrestrial solar utilization as base load
- 1% [of SSP MLEO] Orbital solar reflectors a very interesting “halfway house”

Global Warming “Solutions”

- **Green Energy ,Conservation**
- **Genomic Biologics w/greatly increased CO2 Uptake**
- **Trigger/Engineer Calderas [Nascent Volcanoes],Put massive amounts of dust in the Atmosphere**
- **Nano-Particulates spread on the monolayer of surfactant on the Oceans’ Surface to alter Albedo**
- **Gigantic reflective films/membranes in orbit**
- **Seed Oceans with iron to provoke/enable Phytoplankton Blooms**

The “Final” [Last Resort] Solution

- **Genomically modify the Biota [incl. humans] to “Take the Heat”**

- Ongoing studies of “Extremaphiles’, biologics in deep ocean vents, in deserts, in Yellowstone pools etc. plus the ongoing Bio Revolution [Genomics, Synthetic Biology] proffers the possibility of Designer Life forms [incl. Humanoids] capable of thriving in whatever evolves [Venus-like conditions is a “worst case” - ~ 400 degrees C if all the Ocean Methane “Escapes”]

Nominal Power Densities

- **ZPE……..E108 X Chemical**
- **Anti-Matter/Positrons….. E10 X Chemical**
- **Fission/Fusion…….. E6 X Chemical**
- **Isomers……. E5 X Chemical**
- **SBER…… E2 X Chemical**
- **Hydrogen……..……..38 KWH/Kg**
- **HC……..14 “**
- **Advanced Flywheels……. .9 - 20? “**
- **Batteries…….. ……. .04 - 10? “**
- **SMES…… .0015 - ~100? “**
- **Super/ultra Capacitors…… .0007 -8? “**

Energetics “Wild Cards” Being Worked

- Solitons for Low Divergence Power Beaming
- Positron Storage as Positronium
- High Efficiency Plastic Nano PV
- 30%+ Thermo-Electrics, adv. Bioreactors
- High Efficiency [KW/KG] Fuel Cells
- “On-Site” H2 Generation vice Storage [Zinc,….]
- Room Temperature S-C, IECF P-B11
- Tapping ZPE, High Yield LENR’s, 4th Gen Fusion
- Controlled Nuclear Isomer Energy Release
- SMES with CNT Magnets, Jet Stream windmills
- Lithium Tantalate Crystals
- CO from CO2 via artificial photosynthesis

Comments on ZPE

1. ZPE [Energy at Zeroth Quantum State] as a physical entity is “real”, based upon both extensive theory and diverse experimental observations.
2. The “True”/”Exact” nature of ZPE is currently contentious, Dark Energy indicates ZPE has Cosmological Importance but far less than results of integration out to the Plank Scale indicates
3. There are some 7 [or so] technological approaches to tap ZPE under study…Results TBD

First-Order Impacts of Nano upon Energetics

[Improved Performance/Cost & Requirement Reductions]

- Fuel Cells, Thermal-Electrics
- Photovoltaics, Artificial Photo-Synthesis
- H2 Storage [Casimir Forces?]
- Ultracapacitors
- Batteries, Room Temperature S-C
- Structural dry weight reductions [1/3rd-1/8th]

Potential & Critical Impacts of Genomic and Synthetic Biology on Warming/Energetics

- **Terrestrial and Ocean Biota that thrive in the emerging conditions**
- **Optimized Terrestrial & Hydro Biomass including halophytes, algae, Bacteria**
- **[greatly] Enhanced Bio CO2 & Methane Sequestration, including oceanic algae**
- **Reflective Albedo?, Reduced Production of Reactive Nitrogen**
- **Bio-refining, bio fuel cells,**

[An] Outlook for H2

- **Green H2 is [eventually] doable**
- **H2 Infrastructure would take too long to put in place [compared to warming/petroleum problem[s] time scales] and is exceedingly expensive**
- **Hydrogen Storage is still nascent, Nano Tech including Casimir Force Engineering could "help"**
- **Fuel Cells cost too much/weigh too much…**

- **Bottom Line[s]……Biofuel[s] [using existing infrastructures] are/will be the Green transportation fuel of choice.**

[Well Known] Sugar Ethanol Issues [why Biofuels will be Cellulosic, Halophytes and Algae]

- Order of 25% net energy [Biodiesel order of 90%]
- Order of 75% Energy density [Biodiesel 100%]
- Usually competes with Food for fertilizer, arable land, fresh water,potential CO2 Increase[s] due to land clearing
- Cost[s], Equipment/infrastructure incompatibilities, capacity shortfall

“Ways Forward”……

Suggested Green Energy Best Bets/“Ways Forward”

- **Seawater Ag, Aquaculture/Algae, Celulosic Biofuels to replace Petroleum for transportation**
- **Drilled Geothermal,Biomass, Solar Thermal and Nano Plastic PV [with thermal storage/T-PV extraction, Hybrid vehicle Distributed Elec. storage or Sterling M-G for Solar night time,also space-based reflectors] and Wind to replace coal**
- **Also - Tidal Currents, 20%-30% Efficient Thermo-electrics [“Harvesting”, cycle efficiency], SMES w/CNT Magnets [10X Chem storage?], extract atmos. CO2/process using solar energy into CO, Fuels**
- **And - Positron storage as Positronium,IECF P-B11 , LENRs, ZPE Expts.**

That was the Capacity Story, This is the Cost Story

- Current Electricity Costs - 4 to 7 cents/KWH

[Coal with sequestration is 9 cents/KWH [MIT]]

- Wind - 6 cents/KWH
- Solar Thermal - 12 cents/KWH [5 by 2012]
- Solar PV - 20 cents/KWH [6 by 2020]
- Biomass Elec. 4 cents/KWH - 10 cents/KWH
- Drilled Geothermal - 4 cents/KWH [MIT]
- Biofuels - $2.70/Gal; [$1.00 by 2020]

PLUS - All the conservation approaches across the board

[Conservation could cut U.S. Greenhouse Gases by some 30%]

Can purchase, now, both designs for and manifestations of what are termed “off-grid”, “autonomous” or “self-sufficient” homes
[Energy, water, waste,food]
- no longer a “fringe”arena

“Conventional Nuc Fission Fuel Cycle Waste a Serious ”Problem” [near term waste storage approach is casks on an open parking lot at an Indian Reservation……],some estimates indicate [once through] fission Nuc fuel “runs out” in the 2020’s [Breeders,Thorium, Mox Fuel, closed cycles would provide very considerable “Extension”]

Some Major Trend[s]

- Distributed Generation vice expensive/central energy sources/processing [reduced cost[s] and transmission losses] via Biomass [grass clippings, leaves, kitchen scraps, sewage,waste water, greenhouses], Solar Thermal [active, passive] and Solar PV, LENR, Thermoelectric, electrostatic and Piezoelectric [incl. rain] “Harvesting”, Wind, Exercise Bikes,Heat Pumps [air,ground], Evaporative Coolers
- Major Reductions in Energy Utilization [Tele-Everything/”Virtual Age”, Conservation, CNT weight and Elec. Loss reductions,Etc…]

- Both “Raise the Bridge AND Lower the River”

Current Distributed Energy Generation Percentage Utilization

- Denmark - 52%
- Netherlands - 39%
- Finland - 37%
- Russia - 31%
- Germany - 18%
- Japan - 16%
- China - 15%

Physics Outlook/Issues

- Quantum and Relativity do not “Merge”
- They do not explain “Dark Energy”[`73% of the Universe]
- They do not explain “Dark Matter”[23% of the Universe]
- They do not provide an “understanding” of “Non-Locality”
- Where did the Anti-Matter Go?……
- Many other “Unsolved Problems”…..

Extant “Explanation” Approaches
[Samples,Additional Degrees of Freedom, Experimental Verification TBD..]

- Time Reversals/Retrocausation, “Un-particles”
- Extra [Spatial] Dimensions
  - Many Worlds/Multiverses
  - String/M/Brane Theories [to 11 Dim.]
  - 5 Dim. Larger Universe/ “The Bulk”
- “Larger Constructs”
  - Bohm Quantum Potential
  - Holographic Universe
  - Puthoff ZPAether
  - The “Bulk”

What is Sought are “Explanations” for Dark Matter/Energy and Non-Locality Etc. which satisfy Occam’s Razor.

Once Found/Determined the Ensuing/Enabled Technologies should be Seriously Revolutionary,including wrt Energy,

Stay Tuned…….

Emerging Solar PV…….

- **< 1 month energy payback vice 3 years**
- **3rd Gen PV cost projected to $300/KW**
- **Thin Film Approaches**
- **Efficiencies [theoretical] to some 75+%**
- **Distributed Roof Applications OR the highway system estimated to co-generate up to 75% of the Power on the Grid**

The land required for a solar plant in the Southwest is, to first order, less than that for coal plant if one includes the land area required for coal mining

An Example of current Ideation - Concepts for Energy Generation from Highways

- Piezoelectrics in roadbed, from vehicle passage
- P-V in roadbed, From highways as “available” cleared “land”, major perspective capacity
- Solar Chimneys/solar thermal, from roadbed solar heating,subsurface heated air channels with turbines in heated air exhaust chimneys

Commentary…….

- The Technologies and Practices of the Industrial age are responsible for Climate Change/Warming
- The technologies of the IT/Bio/Nano Age are capable of “fixing” Warming [via both Green Energy and Conservation] in the nearer future given reasonable Research Support
- Many/Most of these fixes are “Scalable” to the granularity of the Individual, The “PC vice the “Mainframe” version of Energetics

Bottom Lines……

- There is a Plethora of “Green” Energetics and Conservation Approaches
- Given enhanced Research Support there is every reason to believe we can, expeditiously, convert to “Carbon Neutral”
- There are Alternative/Mega Engineering “Solutions” to Warming if “we” decide not to do/do enough of Green Energy/Conservation
- The major impediment to “green” progress is not technology, it is “Culture” [sunk costs/present investments, resistance[s] to change,etc..] and residual economics
- Atmospheric Warming Solution spaces should also consider Eventual 2nd Law Warming issues

“Afterward”…….

- Warming and Energetics will increasingly subsume and change your professional, personal, economic and political lives. [might want to relook at the dystopian films “Soylent Green” and “Bladerunner” - AKA “Do Androids Dream of Electronic Sheep?”].Warming and energetics are becoming Serious-to-**Existential.**
- With the positive feedback loops engaging [another decade or so and there may be no “stopping it”] we are looking at, by 2100, a 6 to 12 degrees C Temp. rise and becoming “ice free”, with an eventual 70M+ ocean rise, from Ocean Circulation changes - anoxic bacteria hydrogen sulfide releases which decimate the ozone layer and poison atmosphere/populations with catastrophic impacts upon economics and species extinction.
- The inertia and tactical nature of the worlds’ political and economic systems will probably not allow us to change fast enough to head this off

The Technological Futures Context, Within 25 Years…….

- Increases in human life span of 1 year/year…
- Machine Intelligence approaching-to-beyond human
- Networked Global Sensor Grid/Global “Mind”
- Warming” / Climate
- Machines/Robotics take-over “Employment”, produce wealth for EVERYONE,
- Molecular Manufacturing
- Humans become Cyborgs far more than today [Brain and Body]
- Revolutionary Energy Sources/Storage

[Nearly] everything goes VIRTUAL

Major Potential LaRC Contributions to ‘Warming”/Energetics

- Climate-level Sensors/Instruments [Strategic Goal 2]
- Reduced Aircraft Fuel Burn [Strategic Goal 4]
- Reduced Aircraft Emissions [Strategic Goal 4]
- Space Solar Reflectors [Gossomer Membranes, Strategic Goal 1]
- Revolutionary 34% efficient Thermal-Electrics for Energy “Harvesting”/cycle efficiency [Strategic Goal 1]